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PROGRAM REVIEW

Pacific Forest Research Centre

1982-83

Environment Canada / Environnement Canada

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VOL ISS 1982-83
PACIFIC FOREST RESEARCH CENTRE. PRO
GRAM REVIEW

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Pacific Forest Research Centre

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Canadian Forestry Service
Environment Canada
1983

Copies of this publication may be
obtained, free of charge from
Pacific Forest Research Centre
Canadian Forestry Service
Environment Canada
506 W. Burnside Road
Victoria, B.C.
V8Z 1M5

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1983
ISSN - 0820-9138
ISBN 0-662-12839-7
Cat. No. Fo 41-3/1983E

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The Canadian Forestry Service
Environment Canada

The Canadian Forestry Service (CFS) is the principal source of federal expertise in forestry. Its general objective is to promote the wise management and use of Canada's forest resource for the economic, social, and environmental benefit of Canadians.

The following are the main functions of the CFS:

1. providing coordinated federal policies to promote forest industry development and better resource management;
2. providing scientific and technical leadership through research and development;
3. providing and analyzing national and international information and statistics as a basis for policy;
4. aiding in developing and certifying codes and standards of product performance;
5. protecting Canada's forests from foreign pests;
6. supporting provincial forest renewal programs to insure permanent viability of the forest resource;
7. fostering the potential use of the forest resource for energy; and
8. contributing to the environmental objectives of the Department of the Environment.

A number of federal agencies are involved in forestry programs, and a Federal Forestry Sector Strategy Committee has been established to coordinate federal forestry activities. The CFS has been designated the lead agency.

In September, 1982, the Canadian Forestry Service assumed responsibility for regional economic development from a forestry standpoint. In this context the Service is required to negotiate federal-provincial forest renewal agreements of intensive forest management practices to meet the objective of the federal forest sector strategy. As a result, the CFS is also involved in the development of economic profiles and studies to identify regional and national needs, and development opportunities.

The Canadian Forestry Service is composed of a headquarters unit, six forest research centres, and two national institutes. The forest research centres are responsive to regional priorities and maintain close liaison with the respective provincial government forestry departments. They also participate in, and frequently lead, national programs. The national institutes provide the focus for programs of national scope. The headquarters unit comprises three directorates — Research and Technical Services, which plans, directs and coordinates the research and development programs and technical services of the CFS; Forestry Relations, Economics, and Development, which handles forestry relations with university, industry and other governments, economic analyses, as well as the coordination of the forestry development and employment stimulation programs; and Finance, Planning, and Administration, which manages the support services of the CFS in planning and program evaluation, finance, administration, and human resources management.

Service Canadien Des Forêts
Environnement Canada

Le Service canadien des forêts (SCF) réunit la majorité des spécialistes fédéraux en foresterie. Son objectif général est de promouvoir l'aménagement et l'utilisation judicieux des ressources forestières du Canada pour le plus grand bien économique, social et environnemental des Canadiens.

Voici les principales fonctions du SCF:

1. fournir des politiques fédérales coordonnées afin de favoriser l'expansion de l'industrie forestière et l'amélioration de la gestion des ressources;

2. fournir une orientation scientifique et technique par la recherche et le développement;

3. fournir et analyser l'information et les statistiques nationales et internationales qui serviront de base aux politiques;

4. aider à la mise au point et à la certification des codes et des normes en matière de performance des produits;

5. protéger les forêts canadiennes en luttant contre les ravageurs éntrangers;

6. appuyer les programmes provinciaux de régénération forestière afin d'assurer la viabilité permanente des ressources forestières;

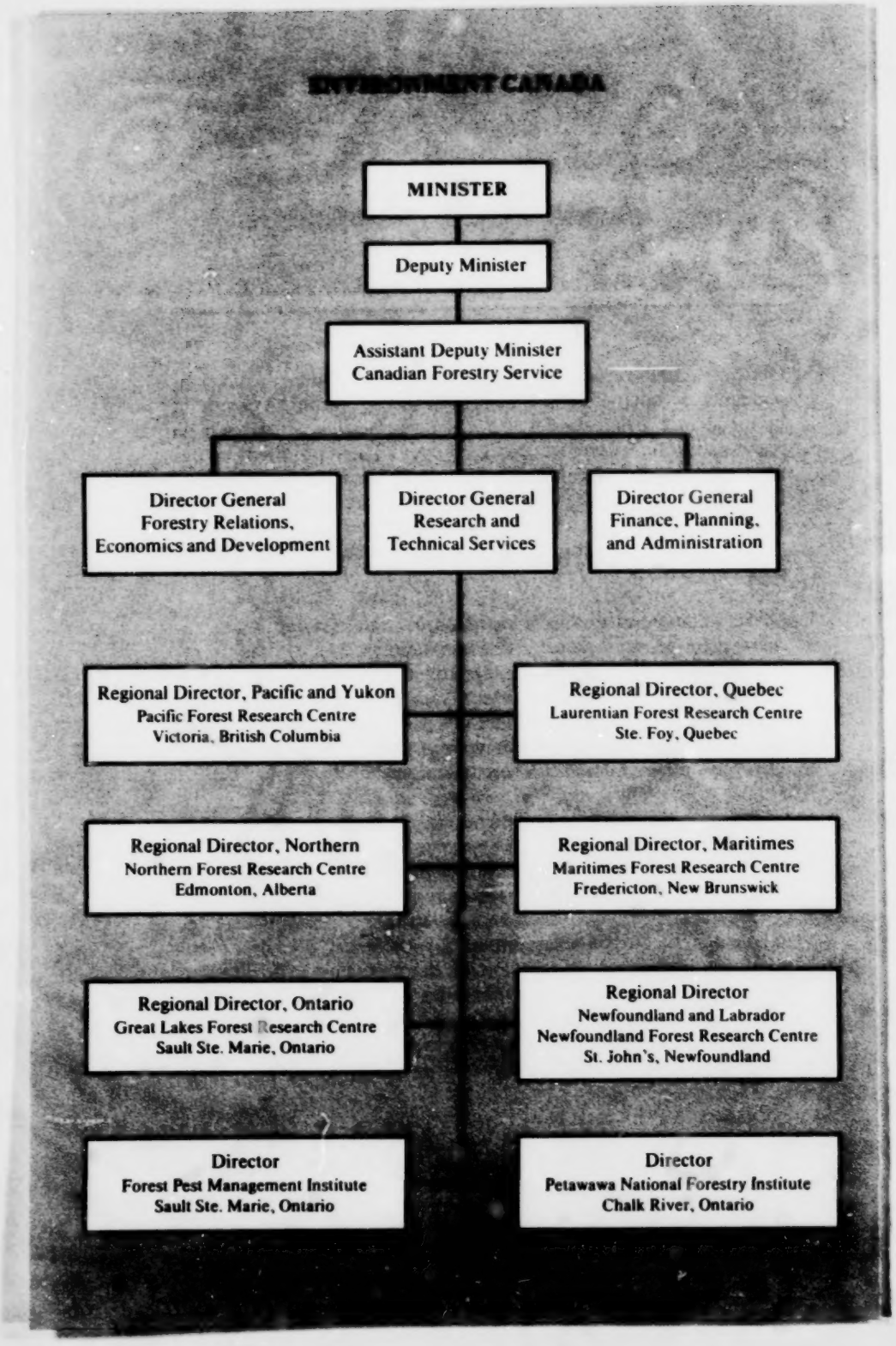
7. parrainer l'utilisation éventuelle des ressources forestières pour la production d'énergie; et

8. adhérer aux objectifs environnementaux du ministère de l'Environnement.

Depuis septembre 1982, le SCF assume la responsabilité du développement économique régional dans le domaine forestier. À ce titre, il doit conclure des ententes fédérales-provinciales, relatives à la régénération forestière, sur des méthodes de gestion intensive des forêts afin d'atteindre les objectifs de la stratégie forestière du Canada. Le SCF doit conséquemment participer à la mise au point de profils et d'études économiques afin de cerner les besoins sur les plan régional et national, de même qu'aux possibilités de développement.

Le SCF comprend une administration centrale, six centres de recherche forestière et deux instituts nationaux. Les centres de recherche forestière doivent répondre aux impératifs régionaux et entretenir une liaison étroite avec les ministères provinciaux des Forêts. Ils participent également à des programmes nationaux dont ils assument fréquemment la direction. Les instituts nationaux sont les foyers des programmes d'evergure nationale.

l'Administration centrale comprend trois directions générales: Recherche et Services techniques, dont le rôle consiste à planifier, diriger et coordonner les programmes de recherche et développement ainsi que les services techniques du SCF; Relations Économie et Développement, qui s'occupe des relations forestières avec les universités, l'industrie et les autres gouvernements, d'analyses économiques ainsi que de la coordination des programmes de développement forestier et de création d'emplois; et Finances, Planification et Administration, qui dirige les services de soutien du SCF dans la planification, l'évaluation des programmes, les finances, l'administration et la gestion du personnel.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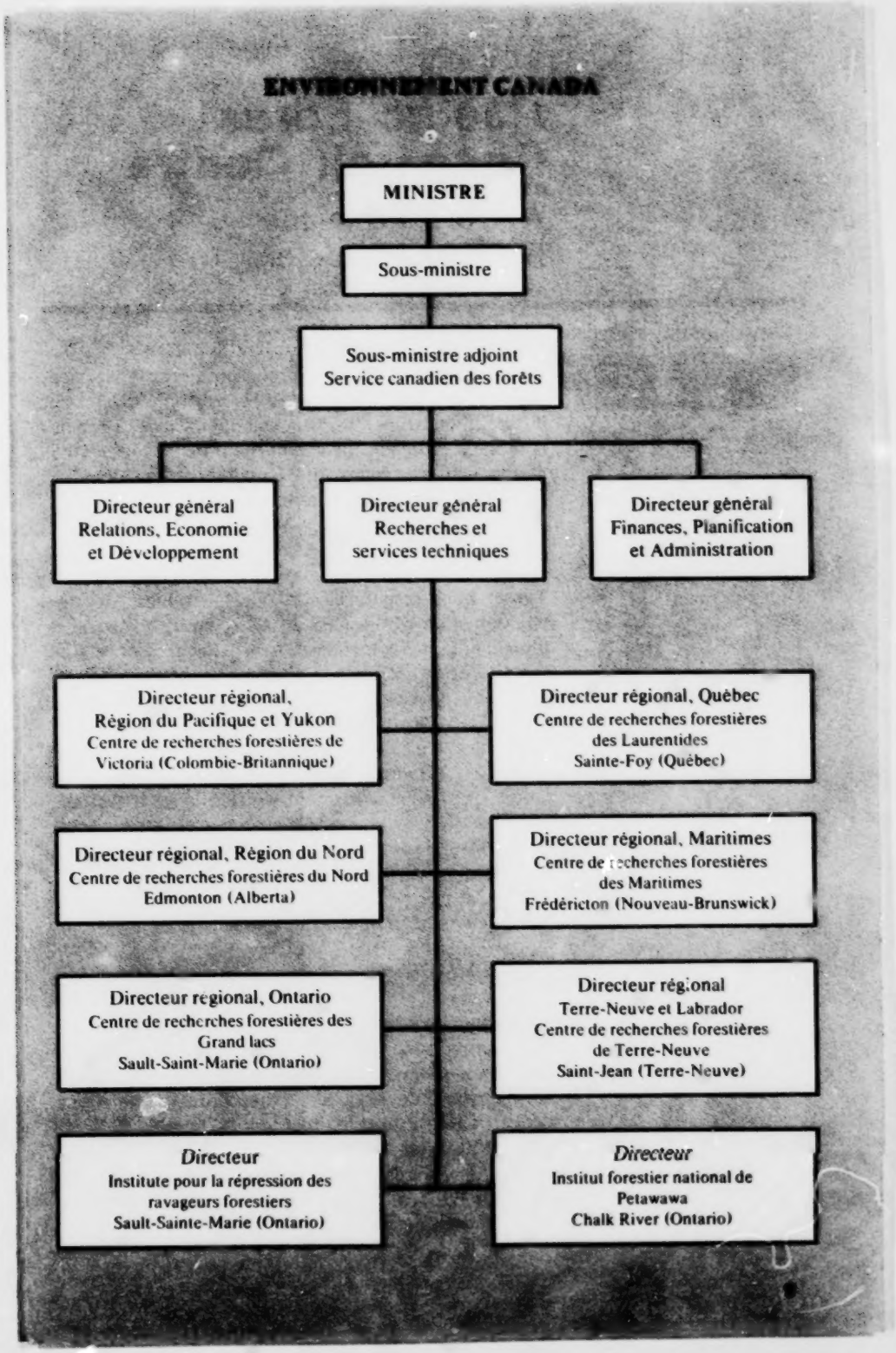
Forest Pest Management Institute
Sault Ste. Marie, Ontario
Director
Petawawa National Forestry Institute
Chalk River, Ontario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et Administration
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Directeur
Institute pour la répression des
ravageurs forestiers
Sault-Sainte-Marie (Ontario)
Directeur
Institut forestier national de
Petawawa
Chalk River (Ontario)

Pacific Forest Research Centre

A Word From the Regional Director

D. Ross Macdonald

In September, 1982, the Canadian Forestry Service (CFS) assumed responsibility for regional economic development from a forestry standpoint. In the Pacific and Yukon Region this meant the transfer to the CFS of the management of the Canada/British Columbia Subsidiary Agreement on Intensive Forest Management from the Department of Regional Economic Expansion (DREE).

These new responsibilities have resulted in the strengthening of the CFS at the regional level and a broadening of it's mandate. At the Pacific Forest Research Centre (PFRC), a Forestry Development and Relations group was formed, headed by **John Edwards**, a former Manager of Program Implementation with DREE. The group's prime function is to undertake the administration of the existing federal/provincial agreement which expires in March, 1984, as well as plan and develop new agreements. Under Mr. Edwards' direction staff also direct activities toward improving communications and relations with forestry sector clients in the region and providing for the timely transfer of research and technology.

Six new professional staff members have been hired in support of this program. The existing forest economics staff have been amalgamated with this group. New staff members include: **Vic Ulrich**, Senior Agreements Implementation Officer; **Dean Mills**, Implementation Officer; **Jack de Lestard**, Senior Forestry Relations Officer; **Craig Edwards**, Technology Transfer Officer; **Gordon Skinner**, Senior Program Planner and, **Sandy Fraser**, Economist. **Glenn Manning**, Senior Economist and **William White**, Economist, have transferred

to the Forestry Development and Relations program. Commencing April 1, 1983, six projects including planning, job creation, forestry liaison and technology transfer, economics, development agreements — implementation and development agreements — negotiation, have been formed in support of this new program.

The federal/provincial job creation program, created in the summer of 1982 to alleviate high unemployment in the forest sector, was an overwhelming success in the Pacific and Yukon Region. Known as the Employment Bridging Assistance Program (EBAP), it employed almost 6 000 people working an average of 14 weeks each on some 570 projects. More than half the national CFS committment was spent in this region — most of the money going into the small communities hardest hit by unemployment.

The 12th Commonwealth Forestry Conference, held every four years to which representatives from more than 60 Commonwealth countries attend, will be held in Victoria in 1985. **Cliff Brown**, Program Manager of Forest Environment, has accepted an assignment as Secretary-General of this event and many staff from PFRC and the provincial Ministry of Forests will assist him with arrangements.

Approval was given to go ahead with a building addition and renovation program at PFRC during this review period. The Wade Williams Partnership, architects and designers for the undertaking, tabled their final project brief as background design research required as the basis for the preliminary design stage. This brief was a detailed review of required facilities to be incorporated into design and construction of the

building addition and renovation of existing structure. The management of PFRC accepted the project brief and the architects proceeded to the next stage.

In an on-going process about one-third of the Centre's projects underwent intensive review by committees representing the management of PFRC, other scientists and members of the research community outside the Centre. Some projects were terminated with a view to placing more emphasis and resources on current CFS priorities such as biological control.

The 30 projects and over 150 studies conducted at the Pacific Forest Research Centre are divided into four major areas:

Forest Environment. Federal responsibilities in the Forest Insect and Disease Survey and plant quarantine are carried out in cooperation with other federal and provincial agencies. Research includes ways to improve the Canadian Forest Fire Danger Rating System as it relates to British Columbia and the Yukon, as well as investigating meteorological and hydrological influences on forest ecosystems. Environmental impact assessments of major construction projects are carried out.

Forest Resources. Research and operations studies involve land classification, improving quality and production of seedlings, and developing improved regeneration methods and silvicultural practices to enhance the productivity of coastal and interior forests. Federal responsibilities in seed certification and testing are carried out.

Forest Protection. Research and operations include studies of insect and disease influences and forest depletion, as well as development of pest management strategies and guidelines, and the development of guidelines for the recognition, control and prediction of growth of stem diseases.

Forest Economics. Policy advice on Canada's greatest forest region is provided, as well as the operation of the region's program in energy from forest biomass.

D.R. Macdonald
Regional Director
Pacific and Yukon Region

March 31, 1983

Forest Environment

C.E. Brown, Program Manager

Forest Insect and Disease Survey

Project Leader:
G.A. Van Sickle

Professionals:
D. Evans
Dr. J.C. Hopkins
Dr. T.L. Shore

Technicians:
R.J. Andrews
R. Duncan
R.D. Erickson
R. Ferris
R.W. Garbutt
N. Humphreys
H.P. Koot
J. Loranger
D.P. Lowe
E. Pass
R. Turnquist
L.S. Unger
J. Vallentgoed
C.S. Wood
R.O. Wood.

Objectives

To produce part of an annual national overview of important forest insect and disease conditions and their implications. To conduct quarantine-related surveys and activities. To support research through collections and maintenance of historical records, monitoring and reporting and when possible, providing requested collections and observations. To develop methods to measure pest-related tree mortality and growth losses, and to improve forest insect and disease sampling techniques.

Achievements

The annual monitoring and assessment of forest pest conditions in British Columbia and Yukon was conducted and results were published. The most damaging insect in western Canada continued to be mountain pine beetle. Spruce beetle infestations also continued over large areas.

Defoliation of Douglas-fir by western budworm declined slightly, whereas there was an elevenfold increase in the area of Douglas-fir stands defoliated by tussock moth. Major problems in mature and immature forests continued to be root rots, dwarf mistletoes, stem rusts and canker diseases, with several needle diseases conspicuous on pines. Outbreaks of black army cutworm killed or damaged more than 32 500 newly planted conifer seedlings in recently slash-burned sites in the northern interior. A terminal disease was found for the first time in North America,

and for the first time on western hemlock, on seedlings in a Lower Mainland nursery. Several cone and seed pests were widespread and were severe in some areas. A larch sawfly outbreak severely defoliated over 12 000 ha of larch stands in 50 locations in southeastern British Columbia.

Projections

A general survey in support of a national overview of important pest conditions will be conducted and reported. A compilation of past records of parasites of common insects of B.C. and another on pine insects are in preparation. A booklet on "Pests of Second Growth" is also being researched and written.

FIDS ranger taking samples.

Effects of Harvesting and Site Preparation Practices

Project Leader:
Dr. R.B. Smith

Professional:
P.R. Commandeur

Technician:
E.F. Wass

Objectives

To identify, measure and explain the effects of harvesting and site preparation practices on forest ecology and productivity to support existing good practices and develop new practices where required.

Achievements

Organic carbon, carbonate carbon and total nitrogen analyses were completed for soil samples collected from skidroads in interior B.C. and statistical tests of these data are in progress.

Field studies investigating the impacts of root disease control techniques on soils were conducted - specifically the effect of stumping and subsequent raking on site productivity.

Natural revegetation was studied on an additional 25 landslides in the Queen Charlotte Islands. Sampled slides now cover a range in age from 1 to 125. Data are being assessed to determine the need for additional sampling.

Advice and services continued through participation in such groups as the Tsitika Watershed Hydrology Sub-committee and the Babine Watershed Change Steering Committee. Seminars and papers on impacts of forestry operations were presented at the Canadian Hydrology Symposium in Fredericton, New Brunswick, the Pacific Science Congress in New Zea-

land and at various meetings and workshops in British Columbia.

Projections

In 1983/84 plans call for the preparation of a paper on the characteristics of skidroad soils. Field work will continue on the root disease study. Plans also call for analysing soil, tree disc and core and plant samples as well as summarizing and analysing data collected during the Queen Charlotte Islands landslide revegetation investigation.

A sand cone is one technique used to measure the bulk density of a soil.

Fire Research

Project Leader:
B.D. Lawson

Professionals:
A. Auclair
B.C. Hawkes

Technicians:
G.R. Lait
G.N. Dalrymple

Objectives

To develop methods for quantifying and predicting fire effects in forest ecosystems and frameworks and guidelines for incorporating fire effects knowledge into land management plans and practices. To develop systems for the prediction of fire behavior with regard to major fuel types in the region and to provide information support systems necessary for implementation. To improve the application of prescribed fire to a variety of land management problems.

Achievements

The PFRC fire group participated in the 1982 fire behavior study in a black spruce - lichen fuel type in the Northwest Territories. This was a joint study involving CFS fire researchers from all four CFS fire groups across the country, in cooperation with the Department of Northern and Indian Affairs. The study resulted in collection of sufficient fire behavior data to produce a new Fire Behavior Index for this fuel type, which will form part of a planned new edition of the Canadian Forest Fire Danger Rating System.

A study to provide fire management planning information to Parks Canada, Prairie Region, was concluded with the submission of a report and a symposium paper on the fire history, fire ecology and fuels evaluation for Kluane National Park in the western Yukon.

Progress continued on the joint BCMF/CFS Northern Fire Ecology Project in northern B.C. which is docu-

menting the ecological effects of fire in the various forested ecosystems of the Fort Nelson, northern Mackenzie and Cassiar Timber Supply Areas. Reports were completed during the year on the Fort Nelson TSA (Timber Supply Areas) with the remainder scheduled for completion during 1983.

Assistance was provided to the Yukon Forest Service in settlement protection planning. A fire hazard evaluation scheme was developed and modified for Yukon conditions. Fuel breaks and fuels modification plans are being developed and implemented in several Yukon communities, including Watson Lake and Mayo.

Field trials were conducted of a modification to the PFRC Aerial Ignition System (AID) which automatically feeds incendiary balls into the dispenser hopper.

Projections

The fire research group will contribute to a new edition of the Canadian Forest Fire Danger Rating System, a joint study with other research centres conducted under the auspices of the CFS Fire Danger Group. As well, they will assess fire effects research needs in British Columbia.

Environment Assessment

Project Leader:
Dr. W. Stanek

Technician:
D. McHarg

Objectives

To fulfill the Canadian Forestry Service's responsibilities in the Environmental Assessment and Review Process (EARP) in the Pacific and Yukon Region by ensuring that environmental effects are considered in federal projects. To acquire and report baseline data in relation to environmental matters.

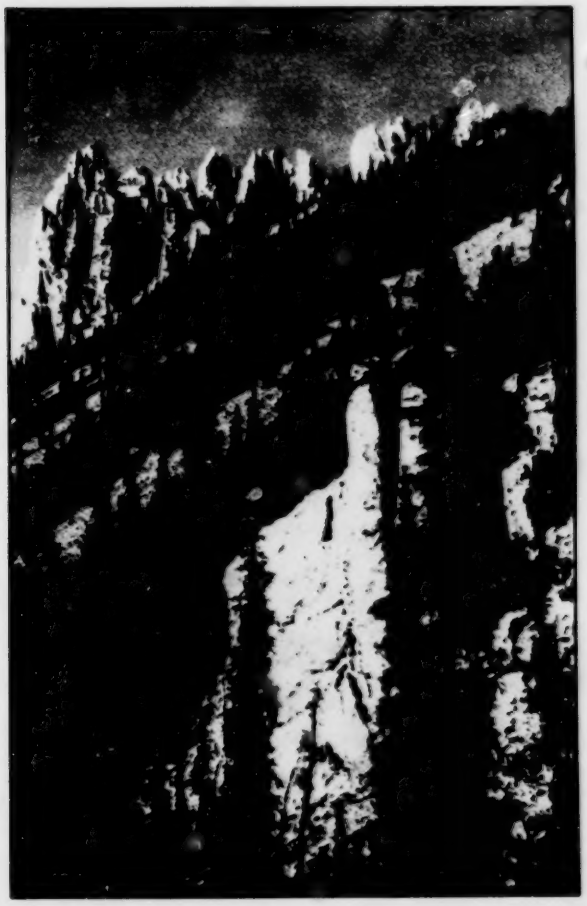
Achievements

Projects reviewed included: environmental impact statements in the gas pipelines (Foothills Proposal), oil pipelines (Trans Mountain's, Foothills' and overland routes, and Kitimat's), Shakwak Highway Improvement, Queenstake Dredging Proposal and Hat Creek coal-fired, electricity generating plant. Initial Environmental Evaluation was completed for the Canada/B.C. Subsidiary Agreement on Intensive Forest Management. Consultations, (Liquified Natural Gas, Yukon placer mining, IBP reserves, logging, pollutants), and specialist witnessing were provided. Many confidential reports and reviews were written. Four major reports on vegetation types and environmental factors and 28 vegetation type maps were completed.

Projections:

Representation of the CFS in the Pacific and Yukon Region in the Environmental Assessment Review Pro-

cess will continue. Reports will be written on certain soil chemical properties from samples collected from 100 plots along the Dempster Highway, Yukon Territory.



Scenic Yukon landscape.

Meteorology in Forestry

Projection Leader:
Dr. R.H. Silversides

Technician:
R. Benton

Objectives

To acquire and apply meteorological knowledge to assist in the solution of forestry and environmental problems in the Pacific Region. In the shorter term, to develop and test one or more models which simulate climatic influences.

Achievements

A small-area numerical wind model has been successfully run on the UNIVAC computer at the Institute of Ocean Sciences.

The fall of 1983 will mark the third and final year for the collection of climate data at the Sayward forest. The data are being used to examine changes in stand climate following a thinning operation. Technical support continues to be provided to the Fertilization on Snow project. Cooperative studies have been established with the Bark Beetle project, to examine beetle dispersion, and with the Protection of Seeds and Cones project, to study development and dispersion of spores from inland spruce cone rust.

The collection and analysis of climate data during field studies has been fully automated.

Projections

During 1983-84, evaluation of new instruments re-

ceived during the last fiscal year will be conducted and documentation will be completed of the numerical wind model.

Tower gathering climate data in support of bark beetle dispersion research.

Carnation Creek Experimental Watershed

Project Leader:
Dr. R.B. Smith

Professional:
Dr. E. Hetherington

Technician:
R.J. Rowswell

Objectives

To integrate and conduct forestry, hydrology, vegetation and soil studies at Carnation Creek for use in the development of appropriate forest harvesting practices for coastal salmonid-producing watersheds.

Achievements

Experimental work continued at the Carnation Creek Watershed site. A case-study of two landslides and a field study of fog-drip precipitation were initiated. A paper was presented at the Canadian Hydrology Symposium in Fredericton, New Brunswick, dealing with the effects of forest harvesting on the hydrologic regime of Carnation Creek watershed.

Vegetation plots were relocated and reestablished in a recently logged unit and new plots were established in a recently scarified area.

Projections

Plans for 1983-84 include processing of field hydrological data; completion of reports on the physical and hydrological characteristics of certain areas of the watershed and 1976-81 levels of groundwater on the bottom of the valley; and to complete field studies of fog-drip precipitation and landslides.

Damage Appraisal and Remote Sensing

Project Leader:
Dr. G.A. Van Sickle

Professionals:
Dr. R.I. Alfaro
Dr. P. Gimbarzevsky
Dr. J.W.E. Harris

Technicians:
R.G. Brown
A. Dawson
E. Wegwitz

Objectives

To determine the relationships between the level and duration of pest populations and the loss of growth, form or mortality of trees and stands. To investigate and implement, in close cooperation with the National Forest Insect and Disease Survey, new techniques for the measurement of damage caused by forest pests in such a way that they become an integral part of national forestry statistics.

Achievements

Long term damage plot assessments for several insect defoliators continued. Individual trees were sprayed to control western spruce budworm for subsequent determinations of growth increment saved, and cruises to determine the impact of budworm in stands defoliated in the 1970's were completed. Programs and a user's manual were prepared for the tree ring analysis micro-computer system which is now operational.

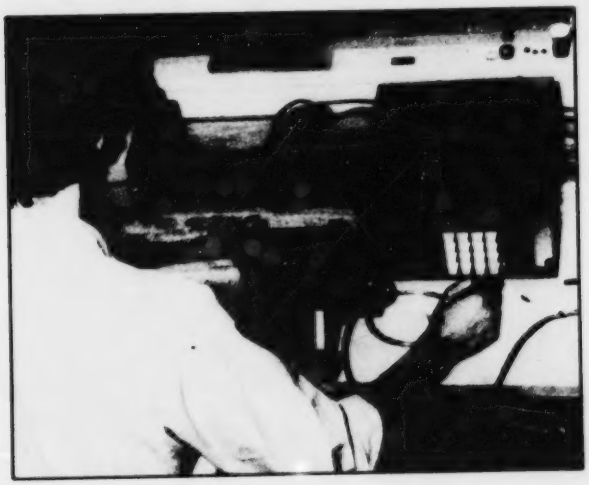
Land slides on the Queen Charlotte Islands were mapped from aerial photographs for a Fish-Forestry Interaction Research Program. Ground, aerial and multispectral scanner data of a selected mountain pine beetle infestation was compared. A survey of biophysical resources in Nahanni National Park, Yukon Territory was completed and reported to Parks Canada.

A photographic guide to defoliation rating and the problems associated with estimating defoliation, and

an information report on a multi-stage sampling system for a mountain pine beetle outbreak, are in preparation.

Projections

Existing appraisal plots in six areas will be reassessed, budworm damage cruise data analysed, growth loss estimates obtained for the 1975-78 tussock moth outbreak, initial material collected to assess losses from sitka spruce weevil, and assessment of the existing dwarf mistletoe data collected.



Tree ring measuring instrument to determine pest impact on tree growth.

Forest Resources

Dr. A. Auclair, Program Manager

Coastal Douglas-fir Ecosystems and Stand Tending

Project Leader:
Dr. H. Brix

Professionals:
Dr. H. Barclay
Dr. V.G. Marshall
Dr. P.C. Pang

Technicians:
M. Clayton
C.R. Layton
K. McCullough
A. Mitchell

Objectives

To investigate tree growth and biological processes of soil and trees in response to thinning and fertilization of a coastal Douglas-fir ecosystem and to use the resulting information to develop a comprehensive model for growth prediction.

Achievements

Research continued on thinning and nitrogen fertilization effects on soil chemistry, soil microflora and fauna and their functional interrelationship in nutrient cycling and nutrient availability to trees. This, together with impacts on tree physiology, is the basis for development of a biological model of stand management effects on ecosystem response and stand growth.

A report on the 9-year stem growth response to thinning and fertilization at Shawnigan Lake was published. These treatments more than doubled the diameter growth compared to untreated trees during the 9-year period. Trees have also shown a good response to refertilization which took place in the spring of 1981. A report on total biomass response is in preparation.

Litter decomposition is an important aspect of the project and effects of microflora, soil fauna, weather and stand treatments are under study; earthworms have been introduced in separate plots to investigate their influence; two new native earthworm genera and species have been discovered.

The fate of nitrogen applied to the forest has been studied intensively. During the past year experiments on nitrogen losses by denitrification were completed and a report was published on distribution of available nitrogen in soil following urea and ammonium nitrate fertilization.

Studies in tree physiology included an investigation of nitrogen composition and concentration in xylem sap following fertilization. A report was published on the response of tree growth to nitrogen fertilization and thinning and its relationship to foliage quantity and efficiency.

Tours were conducted for 78 visitors to the Shawnigan Lake field installation.

Projections

Studies on changes in soil chemistry, tree nutrition, soil fauna and tree growth following the refertilization of the 1972 plots in the spring of 1981 will be continued. The 12-year growth response of the 1972 plots will be measured and chemical analysis of litterfall and biomass will be continued.

Regeneration and Silviculture Systems

Project Leader:
J.T. Arnott

Professionals:
Dr. S. Eis
A.C. Gardner
Dr. R.G. McMinn
D. Macey

Technicians:
D. Barwise
D. Beddows
D. Craigdallie
J.J. Dennis
G.J. Goodmanson
M.A. Grismer
M.T. Hughes

Objectives

To develop, test and demonstrate new nursery systems and improved methods of stand establishment and tending.

Achievements

Nursery research in the past year investigated the growth response of white and Engelmann spruce container-grown seedlings to failure and interruption of extended daylengths at different times in the growing season. New studies on the timing of critical stem unit formation and rates of initiation within the bud for these spruces were also begun. In the mycorrhizal research studies dealing with containerized seedling production, pot trials investigating the response of lodgepole pine, western hemlock and Douglas-fir to the presence or absence of mycorrhizal symbionts were concluded and reports on these studies are being prepared. Furthermore, temperature preference and extremes, plus pH preferences for over 100 fungal isolates were determined.

High elevation species and stock type trials, run in cooperation with the B.C. Ministry of Forests, were evaluated. Third-year survival and growth performance of eight species suitable for outplanting in the coastal high-elevation subzones will be reported in the current Forest Research Review of the British Columbia Ministry of Forests. Fifteen-year-old container-grown plantations are being appraised to determine the long-term growth and possible occurrence of any

tree stability problems which might have arisen from the container systems used.

A study of direct seeding of white spruce on untreated and scarified sites on river floodplains of the southeast Yukon was published this year.

The Shawnigan Lake Level of Growing Stock study was thinned in the winter of 1982/83 thus completing the first treatment period at the site. Data from this, and from the second treatment period at the more-advanced installation at Sayward Forest, will be reported in the coming year.

Projections

A report will be completed on the effectiveness of low-level aerial reconnaisance as a regeneration survey method in the Southern Yukon. Annual appraisals of high elevation species and stocktype trials will be conducted and reported upon. Two reports will be prepared on photoperiodism in white and Engelmann spruce and a new study plan for this work will be developed.

Tree and Seed Improvement

Project Leader:
Dr. D.G.W. Edwards

Technicians:
D. Craigdallie
A. Mitchell
F.T. Portlock
D.W. Taylor

Objectives

To enhance the quality and quantity of forest tree seed supply in British Columbia and the Yukon by improving methods of selection, breeding, production, procurement, processing and utilization. To develop and provide essential services for movement of seed in international trade.

Achievements

Experiments were continued on the influence of temperature and photoperiod, both during and after the flower induction period, and gibberellin applications on flowering in greenhouse grown western hemlock. A flower induction trial on seed trees left in cut-over areas was also continued into its second season. Tests of paste applications of gibberellin are in progress. Flower induction methodologies on grafts, cuttings and seedlings of Sitka spruce are also being investigated.

Seed utilization research continued to focus on *Abies* spp. The separation of viable and non-viable seeds was tested after stratification and again after redrying. The influence of high temperatures (applied to kill insect larvae resident in the seeds) on seed quality was also investigated.

Eight species guides to the interpretation of reproductive strategies in conifers have been completed and four more are near completion. Rating standards for cone crops have been developed.

Eighty-four international certificates of seed quality for seedlots to be exported from Canada were issued in accordance with the International Seed Testing Association rules, while 93 certificates of seed origin were issued under the Organization for Economic Cooperation and Development Scheme. In both instances this is a substantial decrease from 1981 and reflects the economic recession experienced globally. The trade value of the materials tested and certified is estimated to be in excess of $800,000, an indicator of the role and influence of the certification programs. A national list of seed orchards was published.

Advice and services on a variety of topics, including seed quality assessments and seed and pollen supplies, were maintained.

Projections

Both OECD and ISTA seed certification services will continue. Staff will continue to investigate the feasibility of seed and stimulation of germination sorting by moisture control. Experiments will be conducted and reported upon concerning investigations into environmental effects on artificial flower enhancement.

Forest Land Productivity

Project Leader:
Dr. E.T. Oswald

Professionals:
Dr. T.G. Honer
Dr. Y.J. Lee

Technicians:
B.N. Brown
J.F. Dronzek
R.K. King

Objectives

To categorize and map the resources of the Yukon Territory into ecologically sound units suitable for integrated resource planning and management. To develop and maintain an information storage and retrieval system that can incorporate all resource data.

Achievements

Vegetation classification and mapping were conducted on about 20 700 km^2 at a scale of 1:100 000 in the western part of the Carmacks-Roas River Corridor Priority Area. Fuelwood mapping at a scale of 1:20 000 was conducted around the towns of Faro and Roas River. Data from forest plot measurements by PFRC and the Forest Management Institute of the Canadian Forestry Service were entered into computer systems as an aid to determining forest productivity in southern Yukon. Preparations were made for conducting a reconnaissance forest inventory in the Yukon. The first published draft of a national vegetation classification system was presented at a Land/Wildlife Integration Workshop.

Projections

Goals for 1983-84 include establishing field plots and conducting field examinations to obtain data on forest cover, capability, biomass and vegetation successions.

Fate of Nitrogenous Fertilizers Applied on Snow

Project Leader:
Dr. V.G. Marshall

Professionals:
Dr. E. Hetherington
Dr. P.C. Pang

Technicians:
L. Bown
S. Reynolds

Objectives

To conduct field and laboratory experiments for assessing nutrient losses from application of urea and ammonium nitrate and to develop a decision-logic table for applying these fertilizers to forest soils.

Achievements

Analysis continued on urease activity and on nutrients in soil, soil-water, and plant materials, including 15-N fertilized trees. Tree measurements showed that fertilization, off or on snow, had no significant effect on 12-year-old lodgepole pine at Spillimacheen in interior British Columbia. However, at Green Mountain on Vancouver Island there was a 20 and 50% increase over controls in average basal area of 11-year-old Douglas-fir for fertilizer applied off snow and on snow, respectively. Manuscripts dealing with urease activity, ammonia volatilization, and tree response are in preparation.

Projections

Work will be directed to the chemical analysis of the thousands of samples of snow, soil, soil water, and plant material already collected from Spillimacheen and Green Mountain as well as determining the hydrological properties of soils of these two sites.

Supporting Services

Chemistry

Head:
E.E. McMullan
(on sabbatical)

Objectives

To provide efficient, specialized services to the research and other operations of the Centre.

Achievements

The analytical chemistry services continued to provide the required support for the research programs.

Projections

The project leader, Eleanor McMullen will be returning from education leave having obtained her Ph.D. Almost $240,000 will be spent upgrading the facilities of the chemical services lab to better serve the needs of the staff.

Computers and Statistics

Head:
Dr. F. Peet

Professionals:
S. Alers
A. Erickson
Dr. J. Pannekoek
J. Partridge
D. Say
Dr. C.S. Simmons

Technicians:
J.E. Foster
M. Simpson

Objectives

To provide an efficient and comprehensive facility for computation and information processing in order to satisfy the requirements of research and administration at PFRC.

Achievements

The service was utilized by more than 70 research and support staff. The in-house system, a PDP 11/45, supported most of the work. Improved operating procedures were developed. New terminals were installed. New programs were written. A documentation centre and tape library was implemented. A data base system was acquired and evaluated. Existing hardware and software was maintained.

Projections

To continue to keep the computer hardware in working order and the computer operating system up-to-date, as well as provide assistance to users as and when required.

Forest Protection

Dr. T.E. Sterner, Program Manager

Bark and Wood-Boring Insects

Project Leader:
Dr. L. Safranyik

Professionals:
Dr. L.H. McMullen
Dr. H.A. Moeck
Dr. T.S. Sahota
Dr. D.M. Shrimpton
Dr. S. Whitney

Technicians:
R.E. Betts
A. Ibaraki
C.M. Lawko
D.A. Linton
L.E. Manning

Objectives

To develop and promote management guidelines to reduce losses from major bark and wood-boring insects.

Achievements

Eleven scientific and technical publications were produced by project scientists on various aspects of bark beetle problems and control. Pine oil was shown to be effective for prevention of attacks by mountain pine beetle on treated lodgepole pine and trees within 10 m for a duration of two flight periods. Examination of the treated and control trees following the third flight period gave inconclusive results due to the lack of attacks. In a study of dispersal by mountain pine beetle, 30% of released beetles were recovered, some over 1 km from the release site within six hrs of release. The "Tree Monkey", a debarking/delimbing machine for standing trees, is being redesigned by FERIC, on contract to PFRC. This machine is being developed for killing mountain pine beetle broods in single trees or small groups of infested trees. It is especially suited for situations where the traditional methods of treatment, such as logging or felling and burning, cannot be used. Norwegian pipe traps baited with trans-verbenol, myrcene and ethanol, at two elution rates, caught very few mountain pine beetles. Live trees baited with trans-verbenol and myrcene in polyethelene (BEEM) caps were not attacked by mountain pine beetles, possibly because of high tree

resistance and low beetle numbers in the experimental area.

New technology involving microscope photometry and digital cell image analysis, aimed primarily at detection of reproductive differences in insect populations, has been implemented. This system was used to demonstrate differences in two Douglas-fir beetle populations.

Project staff participated in the development of an Action Plan for the joint US/Canada Memorandum of Understanding supplements on the mountain pine beetle.

Dr. Safranyik served as chairman of the technical committee on the mountain pine beetle involving representatives from CFS, Parks Canada and provincial personnel from British Columbia and Alberta.

Projections

Project staff will initiate a cooperative study with mountain pine beetle researchers in the USDA Forest Service, Intermountain Region, on the evaluation of mountain pine beetle hazard rating systems and establishment of demonstration areas.

Defoliating Insects

Project Leader:
Dr. R.F. Shepherd

Professional:
Dr. I. Otvos

Technicians:
T.G. Gray
M. Talmon
de l'Armee

Objectives

To develop pest management systems for the major defoliating forest insects.

Achievements

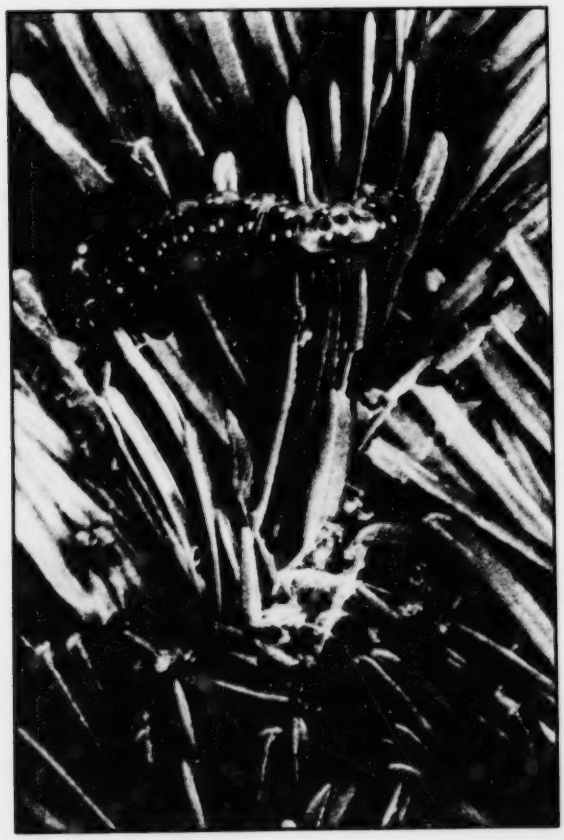
Biological control trials, including a nucleopolyhedrosis virus (NPV) application against Douglas-fir tussock moth and two parasites introduced against the winter moth, were monitored for continued effectiveness.

The virus treatment was effective for at least one additional year after the application. Both introduced parasites of the winter moth have been recovered for the first time. Additional aerial virus trials against the Douglas-fir tussock moth indicated that concentrations, and thus costs, of treatment may be reduced considerably.

A long-term evaluation of two viruses against the spruce budworm was established. The pheromone of the coastal budworm and of the European pine shoot moth was determined and a monitoring system using pheromones to measure Douglas-fir tussock moth pre-outbreak populations was established. A sequential egg-mass survey method was developed to evaluate stands where the pheromone survey indicates potentially damaging tussock moth populations.

Projections

This project was terminated in March 1983 with active studies being transferred to a newly-created project on biological control of forest pests.



Spruce budworm

Root and Stem Diseases

Project Leader:
Dr. G.W. Wallis

Professionals:
Dr. A. Funk
Dr. R.S. Hunt
G.D. Jensen
Dr. D.J. Morrison

Technicians:
D. Chu
H.M. Craig
A.L.S. Johnson
G. Reynolds

Objectives

To assess the significance of root and stem diseases as depletion factors in second-growth stands and, through biological and ecological studies of the fungi and hosts, to prescribe sound control procedures.

Achievements

Two articles on white pine management, one concerned with tree pruning as a method to reduce losses and the other concerned with the feasibility of a hazard rating system for white pine sites, were published during the year. Detailed anatomical and biochemical studies showed that the highly destructive Armillaria root rot disease is caused by at least six genetically distinct, but closely related, fungus species that differ in host preference and geographical distribution. A book describing the foliar microfungi of western trees is nearing the half way completion stage; 50 fungal species have been described and illustrated. *Fomes annosus* root disease continues to present a threat to future managed stands on the Coast; up to 35% of the *Abies* and western hemlock stumps sampled three to five years following spacing contained detectable infection. Incidence of the disease was greatest in western hemlock stumps. Early results indicate that large scale aerial photography should be a useful tool in detecting *Phellinus* root rot centers in second-growth stands of most ages in the future. Workshops and clinics on root diseases and identification of wild mushrooms were conducted.

Projections

Emphasis during 1983-84 will be on completing field sampling to determine the minimum stump size that would provide inoculum potential for infection of crop trees by *Fomes annosus* following spacing. Staff will attempt to determine stand conditions that govern impact of black stain root disease in lodgepole pine stands. Consultations and workshops on root and stem diseases and wild mushrooms will be conducted.

Dr. Gordon Wallis (centre with hard hat) leads one of many root rot workshops.

Pest Management Systems

Project Leader:
Dr. W.J. Bloomberg

Professionals:
Dr. L.H. McMullen
Dr. A.J. Thomson
S. Moncrieff

Technician:
A.A. Hall

Objectives

To develop computer systems applications for management of four major insect and disease pests of forest stands.

Achievements

A dwarf mistletoe model has been validated for second-growth western hemlock on southern Vancouver Island and used to illustrate control guidelines. A spruce budworm population dynamics and impact model with applications, as well as a root rot model, have been completed and published. A computer graphics system for topography display has been developed. On-line versions of root rot and dwarf mistletoe models have been developed for forest management and educational purposes. An impact analysis model has been developed for estimating insect and disease losses.

Projections

Project staff will continue their work on the estimation of the impact of *Phellinus* root rot on stand growth and analysis of existing data for impact of dwarf mistletoe on submature western hemlock. Studies of western spruce budworm and mountain pine beetle populations are continuing.

Protection of Seeds, Cones and Seedlings

Project Leader:
Dr. J.R. Sutherland

Professionals:
Dr. G.E. Miller
Dr. T. Sahota

Technicians:
W. Lock
D.S. Ruth
T.A.D. Woods

Objectives

To identify the major insect and disease pests of forest nurseries, seed orchards and reforested areas. To develop pest management strategies to keep the incidence of these pests below economic thresholds. To develop techniques that allow early detection and meaningful predictions regarding the pests. To assist in transferring new technology developed as a result of this research.

Achievements

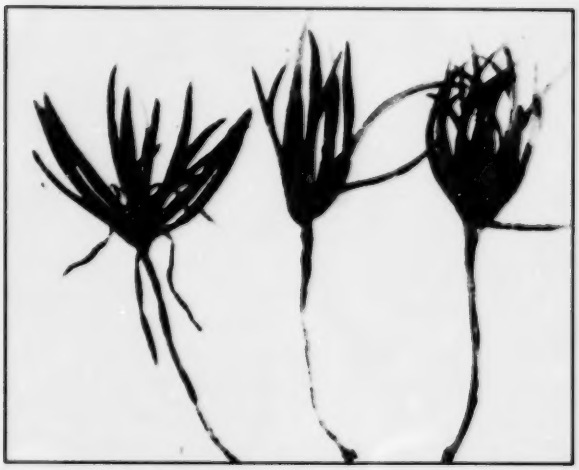
In technology transfer, pest diagnostic and liaison services continued in nurseries and seed orchards. Pesticide control trials were made for spruce cone rust and Douglas-fir cone and seed insects. Lectures and seminars were presented on research results and implementation of research findings. In the cone and seed insect study, work was done on developing sampling techniques for Douglas-fir cone gall midge and to determine the effect of pheromone trap factors, e.g., trap color, on catches of Douglas-fir cone moth. Trials with mauget injectors showed that they did not work well with Douglas-fir; future trials will be made with spruce. Research continued on identifying and testing pheromones for various cone and seed insects and seasonal development of coneworms and seed bugs. Work began on: (i) development of a laboratory assay for Douglas-fir cone gall midge, (ii) a study of calling behavior of Douglas-fir cone moth and spruce seedworm females, (iii) identification of pheromone glands of Douglas-fir cone gall midge, (iv) fir seed

midge taxonomy and (v) life history studies of cone and seed insects, especially fir seedworm. In light of recent findings in the study on diapause of cone and seed insects, systematic experiments were carried out to recognize insects in one or two-year diapause before the termination of diapause. The two types of diapause can be recognized several months before diapause termination. This capability allows a better and earlier estimate of potential population of insects available for attacking cone crops. Inoculation of spruce cones with *Sirococcus* were made to determine when infection occurs and seed heat treatment were done to eliminate seed-borne *Sirococcus*. Work continued on: (i) pre- and post-emergence spread of *Sirococcus*, (ii) immunoassay techniques for detecting seed-borne *Sirococcus*, (iii) fungi on *Abies* seeds and (iv) cooperation with T. Sullivan (unsolicited proposal grant 6990-B (UP-N-96). Project personnel published 13 papers and prepared seven more. Gordon Miller completed his Ph.D. degree during the year.

Projections

The overall goals of the technology transfer study will emphasize the service aspects of pest identification and management recommendations for nursery and seed orchard pests. Research on cone and seed insects will continue to emphasis identification of insect pheromones and sex attractants, and development of these into tools for monitoring insect populations. Sampling techniques will be developed for the Douglas-fir cone moth. Life histories of several poorly known species, especially those on *Abies* spp., will be examined in detail. Experiments to examine the host influence on

diapause type will continue. Research on cone and seed diseases will concentrate mainly on the epidemiology of cone rust and the etiology of seed-borne *Sirococcus*.



Sirococcus killed container spruce seedlings.

Chemicals and the Forest Ecosystem

Project Leader:
Dr. J. Manville

Objectives

To assess the role of chemicals in host-pest interactions and to monitor the impact of certain herbicides on commercial conifers and other components of the forest ecosystem. To ascertain, by extensive analytical chemistry, if external stimuli cause chemical changes to occur within plant material and to determine their extent and duration.

Achievements

Studies have been carried out on field application of the herbicide "Round-up" (glyphosate) in order to ascertain the fate of this chemical applied to cool, moist forest soil and litter. The procurement and installation of an organic-analytical chemical facility has been completed. Studies in cooperation with other researchers have led to the development of an improved chemical lure for the European Pine Shoot moth, a pest of ornamental pine trees in British Columbia. Other studies are currently underway to examine the role of terpenes in Western Spruce budworm — Douglas-fir interactions.

Projections

Research will continue on obtaining baseline chemical data from conifer species to ascertain whether or not the use of herbicides induces chemical changes within the plant that are persistent but not visibly apparent.

Supporting Services

Microtechnique Services

Project Leader:
S.H. Farris

Objectives

To maintain a microtechnique service capable of providing the required assistance to the various research studies at PFRC. To develop and refine skills and methodology needed in specialized research including ultramicrotomy.

Achievements

Microtechnique service was provided to two projects encompassing four studies and two papers were published in scientific journals.

The first phase of the examination of nucleic acid characteristics of forest defoliators in a study of population quality as related to population dynamics was completed in cooperation with Dr's. Shepherd and Sahota of PFRC.

The microtechnique aspects of a histopathology investigation of *Chrypomyxa pirolata* infection of spruce cones and the alternate host, *Pyrola* spp. was completed.

Histological examinations continued in a study of the Pharate Adult diapause phenomenon in the development of both one and two year diapause *Barbara colfaxiana*.

A new study was initiated to locate and describe the pheromone gland(s) of the Douglas-fir cone gall midge, *Contarina oregonensis*.

Projections

The project leader retired. Certain microtechnique functions will be conducted by other staff.

The Ultramicratome being used to cut semi-thin sections of plastic embedded tissue for light microscopy.

Forest Economics

Dr. G.H. Manning, Program Manager

Development of Economic Guidelines

Project Leader:
Dr. G.H. Manning

Professional:
W.A. White

Technicians:
C. Macklin
J. Rudd

Objectives

To provide economics and policy advice to the department, its cooperators, and the management and staff of PFRC; and to improve the information base in forest economics.

Achievements

In 1982-1983, the major thrust of the project continued to be in support of the Canada/B.C. Forestry Subsidiary Agreement and provision of policy and economics advice and services to Canadian Forestry Service management. Project staff participated in the development of concept papers with regard to a second generation of forestry subsidiary agreements and in the development and negotiation of a Canada-B.C. job creation program and a similar program for native people in B.C. Studies were completed on federal and provincial forestry revenues, on the relationship between economic cycles and government revenues, and studies were initiated on softwood lumber flows from British Columbia.

Projections

During 1983-84 this project will continue to provide planning, economic and policy advice and liaison as required by the staff and other client agencies. Where required, this will be supported by research studies.

Energy from the Forest

Project Leader:
Dr. G.H. Manning

Objectives

To develop methodology to quantify the amount of forest biomass available for energy conversion in the Pacific and Yukon Region; to assess its cost and uses; and to assess the physical and socioeconomic impacts of its availability and use.

Achievements

Four studies were completed in 1982-1983. The first of these was a contract by Forestal International for the development and testing of a forest residue slasher. The second was conducted by the British Columbia Ministry of Forests to evaluate costs and benefits (including silvicultural benefits) of forest residue harvesting. The contract to develop tree weight equations for the Yukon, performed by Nawitka Renewable Resource Consultants of Victoria, was successfully completed. A contract to develop a model to forecast the amount of slash remaining after logging, performed by Talisman Land Resource Consultants of Vancouver, was also completed.

Research proposals were developed to further test and refine the forest residue slasher, test residue harvesting and transportation, assess the socio-economic impact of joint merchantable-biomass harvesting, and assess firewood supply and demand in southwestern British Columbia. The biomass energy project is being merged into the economics project in the new year.

Projections

This project terminated March 31, 1983. Future contracts will be developed as studies in other projects.

Data from the contract to develop tree weight equations for the Yukon was published.

Administration

J.J. Ellis, Administrator

Administration

Administrative Officer:
J.J. Ellis

Librarian:
A. Solyma

Finance Officer:
J. Cote

Photographer:
A. Craigmyle

Administrative Support:
J. Andersen
B. Baker
A. Couillard
J. DeChamplain
L. Donk
P. Donovan
H. Gray
D.A. Greenway
H. Hendrickson
E.K. Hopps
R. Hughes
A. Inness
G. Kazmiruk
H. Matson
M. Mitchell
S. Oliver
W.A. Pearce

Objectives

To provide a system of financial control and accountability in accordance with statutory and regulatory requirements; to provide general administrative support services including material management, records management, secretarial services, vehicle fleet management and personnel services; and to provide physical facilities for the total centre and 11 field locations.

Achievements

Financial management and accountability was conducted in accordance with the objectives of the centre and all accounts were closed at the fiscal year end in a satisfactory manner. Corrective and preventive maintenance of the physical plant has remained at a high level. The energy conservation program continues to be fine-tuned. Aided by a mild winter, heating fuel consumption was reduced to 177K litres. The Department of National Health and Welfare carried out a survey of laboratory operations with respect to health and safety. The only outstanding carryover from previous inspections is completion of a chemical inventory. Vehicle fleet management was maintained at 50 units with eight vehicles being replaced. Plans were made to convert several units to propane utilizing funds available through the Department of Energy, Mines and Resources.

J.R. Rafter
R.H. Reid
S. Reid
R.M. Richardson
S. Schaub
J. Strobbe
B.J. Vander Heiden

Projections

To maintain all physical plant facilities at a high level of efficiency to meet the needs of the research program without interruption. To explore ways and means of improving energy conservation techniques possibly leading to the use of solar panels to heat domestic hot water. To continue to maintain strong liaison with Facilities Management Division in Ottawa to improve PFRC facilities through the retro-fit program. To provide continued assistance to the Building Addition Committee.

Information Services

E.L. Teske, Information Officer

Information Services

Project Leader:
E.L. Teske

Professional:
S. Glover

Support:
B. Page
J. Wiens

Objectives

To provide the Centre with editorial and graphic services; to act as the channel through which creative contact is maintained with the public, the forest community, national, regional and local news media, editors and printers; to produce booklets, news releases, exhibits; and to handle telephone and written enquiries.

Achievements

Provided the Centre with editorial and graphic services; answered enquiries from clients; published four issues of "Information Forestry"; issued news releases and maintained media contacts; organized seminars and workshops; published PFRC Program Review; provided tours of PFRC for university, community college and high school students as well as some more specialized tours; participated in five major exhibits; edited over 135 articles for journals or research papers; and commenced public relations programs for the employment stimulation and forestry development and relations programs.

Projections

Plans for 1983-84 include developing media and public relations plans in support of the 12th Commonwealth Forestry Conference to be held in Victoria in September, 1985; to provide the Centre with editorial and

graphic services and to develop a public relations program for the upcoming federal/provincial subsidiary agreement on intensive forest management to be signed in March, 1984.

Shopping mall displays — just one method of communicating with the public.

Appendixes

CONTRACTS LET OR SUPERVISED BY PFRC IN FISCAL YEAR 1982-83

Contractor's Name	Contract Title	Amount
University of British Columbia 312 - 6344 Memorial Road Vancouver, B.C. V6T 1W5	Analysis of Conifer Root Extracts	$7,942
University of British Columbia Dept. of Soil Science Suite 139 - 2357 Main Hall Vancouver, B.C. V6T 2A2	Analysis of particle-size soil samples	$4,000
Simon Fraser University Burnaby, B.C. V5A 1S6	Analysis of Nuclear Magnetic Resonance Spectr	$1,000
Her Majesty the Queen in the Right of B.C. Acting Through and Represented by The Ministry of Forests 1450 Government Street Victoria, B.C. V8W 3E7	Evaluation of the Productivity and Cost of Harvesting Wet-Belt cedar and Hemlock Biomass	$209,765

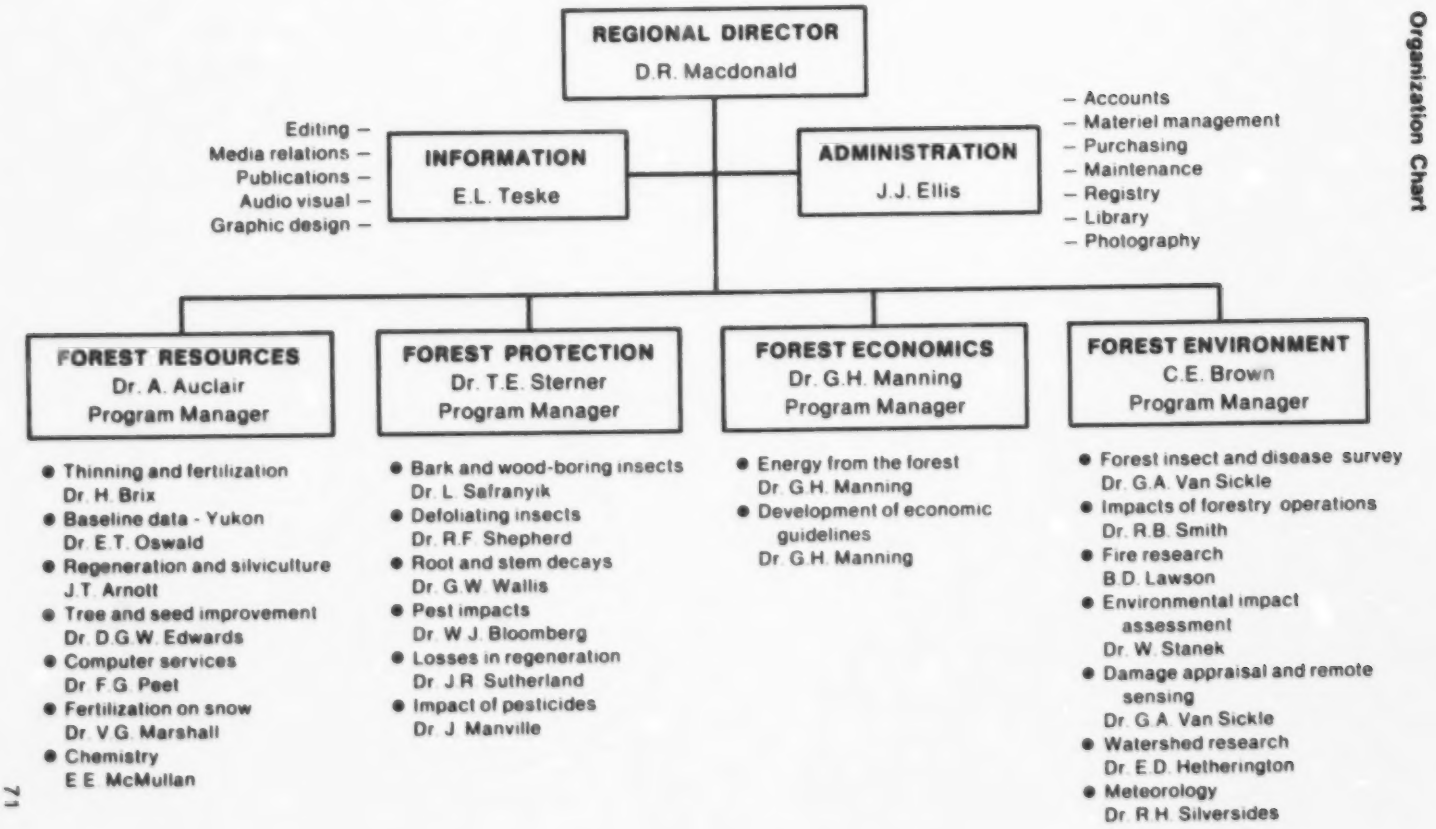
Forestal International Ltd 1550 Alberni Street Vancouver, BC V6G 1A5	Development of a Field Treatment System for Logging Residues to Facilitate Transportation and Subsequent Conversion to Energy - Phase 2	$214,000
Pacific Soil Analysis Inc 1560 Rand Avenue Vancouver, BC V6P 3G2	1 Chemical Analysis on Mineral Samples 2 Soil Analysis on Mineral Soil and Humus Samples 3 Chemical analysis on Foliar Samples	$9,146 $9,746 $10,982
Nawitka Renewable Resources Consultants Ltd 836 - 840 Cormorant Street Victoria, BC V8W 1R1	Development of Biomass Prediction Equations for White Spruce	$89,877
Talisman Projects Inc 1313 West Pender Street Vancouver, BC V6E 2V9	Development of a System to Estimate Quantity of Biomass Following Logging in BC Forest to Specified Recovery Criteria - Part of the Energy From the Forest Program (ENFOR)	$414,538
Forestry Technology Systems Ltd 1058 Brookview Drive Victoria, BC V8X 3W9	Study Forest Fire Research Experimental Plots Near Campbell River, British Columbia	$2,997
	Design and Development of a UHF Telemetry System for the 6100 Fire Weather Stations	$42,545

PACIFIC FOREST RESEARCH CENTRE
1982/83 EXPENDITURES
($'000)

Program Area	Person Years	Salaries (b)	O & M	Capital	Grants & Contributions	Total
Directorate - (includes Information Services)	7	358.8	205.3	7.6	14.9	586.6
Administration	27	708.0	782.6	124.7	0	1,615.3
Resources	39	1,311.8	174.0	47.6	0	1,533.4
Protection	39	1,476.7	169.1	84.1	0	1,729.9
Environment	38	1,379.3	177.4	74.0	0	1,630.7
Development (includes Economics)	8	192.0	564.3 (a)	0	14,500.0 (c)	15,256.3
TOTAL	158	5,426.6	2,072.7	338.0	14,514.9	22,352.2

(a) Includes Biomass Project O&M
(b) Includes Summer Students Salaries
(c) New For 1982/83
- Includes 9,500,000 Job Creation Program
- Includes 5,000,000 Intensive Forest Management Sub-Agreement Transferred from DREE

PACIFIC FOREST RESEARCH CENTRE ORGANIZATION CHART



Organization Chart

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POOR

QUALITY

ORIGINAL